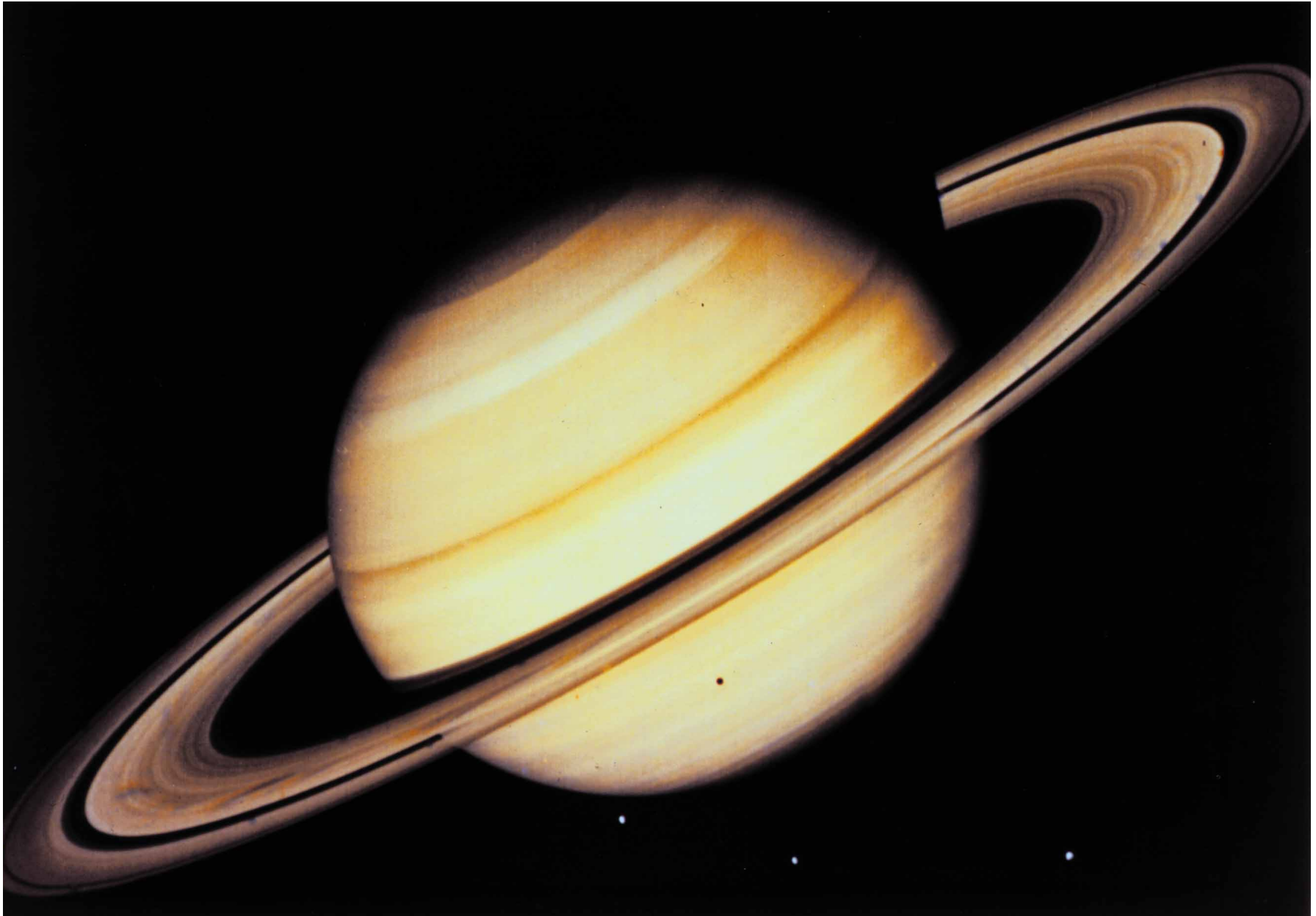




National Aeronautics and  
Space Administration

Saturn 





**SATURN**, the sixth planet from the Sun, is one of the five planets visible from Earth without a telescope. Since the 17th century, when Saturn's dazzling, complex ring system was first observed by the Italian astronomer Galileo Galilei, the planet has stood as a symbol of the majesty, mystery, and order of the physical universe. Over the past 20 years, we have discovered that Jupiter, Uranus, and Neptune also have rings; however, Saturn's ring system is the most extensive and brilliant. Although the origin of the rings is unknown, scientists hope to uncover clues by studying the planet's history.

A giant, gaseous planet, Saturn has an intriguing atmosphere. Alternate jet streams of east-west and west-east circulation can be traced in the motions of the cloud tops; the speeds of these jet streams reach as much as 1,000 miles per hour and are responsible for the banded appearance of the clouds. The atmosphere consists mostly of hydrogen and helium, but also includes trace amounts of other elements. Electrical processes and heat from internal planetary sources enrich the layered chemical mix of the atmosphere, which probably transitions from superheated water near the core to the ammonia ice clouds that are observed at the cloudtop. The planet's atmosphere also features storm structures similar to Jupiter's famous Great Red Spot.

Although Galileo was the first to see Saturn's rings (in 1610), it wasn't until 1659 that the Dutch astronomer Christiaan Huygens, using an improved telescope, observed that they are actually separate from the planet. In 1676, the French-Italian astronomer Jean Dominique Cassini first observed what appeared to be a division between the rings now known as the Cassini division. Improvements in telescope over the next three centuries revealed much about the mysterious planet: the banded atmosphere, the storm "spots," and a very apparent "flattening" at the poles, three features Saturn was observed to share with Jupiter.

Over the past two decades, a series of spacecraft (see "Significant Dates") flew by Saturn, giving us our first close-up looks of the planet, and revealing to us a Saturnian magnetic field 1,000 times stronger than

Earth's. Previously unobserved rings and moons were also discovered. Some moons were found to be covered with very smooth ice. Also, visible and infrared observations of Saturn showed us a surprising mix of thermal patterns among the cloud bands, suggesting internal processes yet to be understood. The *Voyager* spacecraft discovered hundreds of ringlets within Saturn's major rings. Some ringlets were found to be "braided." Some had small moons flanking them (called "shepherding" moons), and all gave the impression of great dynamism. Shadowy "spokes" were seen to develop and dissipate in the rings. Ring particles were found to be composed mostly of ice crystals, and to range in size from a few centimeters to a few meters.

Today we know Saturn to have 7 major ring divisions and 18 moons (Space Telescope in 1995) (two and possibly four new moons were discovered by the Hubble Space Telescope in 1995.) The rings may be the remnants of moons destroyed by tidal interaction with Saturn's gravity. They may include remnants of comets that passed too close to Saturn and were likewise destroyed. Of the 18 known moons, Titan—the largest—has held the attention of scientists most. A bit larger than Mercury, Titan is shrouded by a thick nitrogen atmosphere that might be similar to what Earth's was like long ago. Further study of this moon promises to reveal much about planetary formation, and perhaps about the primordial Earth as well.

*Cassini/Huygens* a joint U.S.-European orbiter/probe mission to Saturn and Titan, will be launched in October 1997, arriving at the Saturnian system in 2004. *Cassini/Huygens* 4-year scientific mission is dual: to complete a multispectral, orbital surveillance of Saturn, and to investigate Titan. *Cassini/Huygens* will measure the planet's magnetosphere, atmosphere, and rings, and observe some of its icy satellites and Titan during close flybys. The orbiter investigation of Titan will be augmented by an instrumented probe—called the Huygens Probe—that will descend through Titan's atmosphere and send back data about the atmosphere and surface. If the *Cassini/Huygens* mission goes as planned, theories of the solar system's evolution and chemical processes on primordial Earth may be improved.

## Fast Facts

<b>Namesake</b>	Roman God of Agriculture
<b>Distance from Sun</b>	1,429.4 Million Kilometers
<b>Period of Revolution (One Saturnian Year)</b>	29.46 Years
<b>Equatorial Diameter</b>	120,536 Kilometers
<b>Atmosphere (Main Components)</b>	Hydrogen and Helium
<b>Moons (Known) in Increasing Distance from Planet:</b>	
Pan, Atlas, Prometheus, Pandora, Epimetheus, Janus, Mimas, Enceladus, Tethys, Telesto, Calypso, Dione, Helene, Rhea, Titan, Hyperion, Lapetus, Phoebe	
<b>Rings (8)</b>	D, C, B, A, F, G, E (The <i>Cassini</i> Division is Visible Between the B and A Rings.)
<b>Inclination of Orbit to Ecliptic</b>	2.5°
<b>Eccentricity of Orbit</b>	0.056
<b>Rotation Period (One Saturnian Day)</b>	10 Hours 40 Minutes
<b>Inclination of Axis</b>	26°44'

## Significant Dates

- 1610 — Galileo Galilei discovered Saturn's rings.
- 1659 — Christiaan Huygens discovered that Saturn's rings were separate from the planet.
- 1676 — Jean Dominique Cassini discovered the *Cassini* division.
- 1679 — *Pioneer 11* passed within 22,000 km of Saturn's cloudtops (9/1/79) and provided the first images of polar regions, imaged Titan, and detected presence of internal source of heat in Saturn.
- 1980 — *Voyager 1* passed within 125,000 km of Saturn's cloud tops (11/12/80) and sent back 17,500 color images; measured high wind speeds in Saturn's equatorial region; imaged five moons; measured Titan; size.
- 1981 — *Voyager 2* passed within 101,000 km of Saturn's cloud tops (8/25/81) and provided detailed imagery of rings, imaged intermediate sized moons; measured and made compositional studies of Titan's atmosphere.
- 1997 — The *Cassini/Huygens* spacecraft will be launched toward the Saturnian system.
- 2004 — *Cassini/Huygens* to arrive at Saturn.

### References

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